MURCHISON GREEN HYDROGEN

Version 1.0 | November 2024

Offshore Facilities

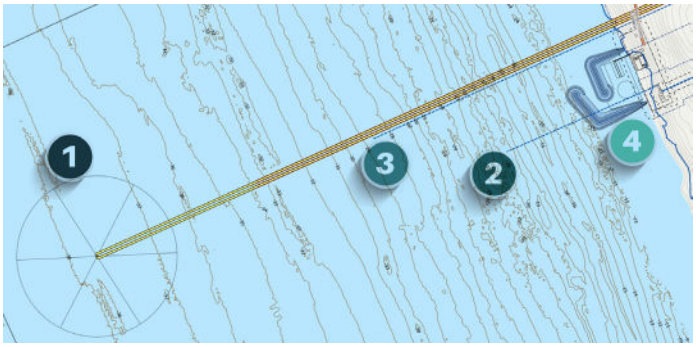
The Murchison Green Hydrogen (MGH) Project will export Australian renewable energy to contribute to global decarbonisation. Hydrogen has been identified as the preferred medium for storage and transport of energy over long distances.

Molecular hydrogen is difficult to transport by ship in large quantities as it would require either very low temperatures or very high pressures.

Therefore, to transport hydrogen safely and efficiently to overseas markets, the Project's green hydrogen will be converted into green ammonia and loaded onto ships through the Marine Export Facility (MEF), an integral component of the Project.

What is included in the Offshore Facilities?

The MEF will comprise of four main elements:

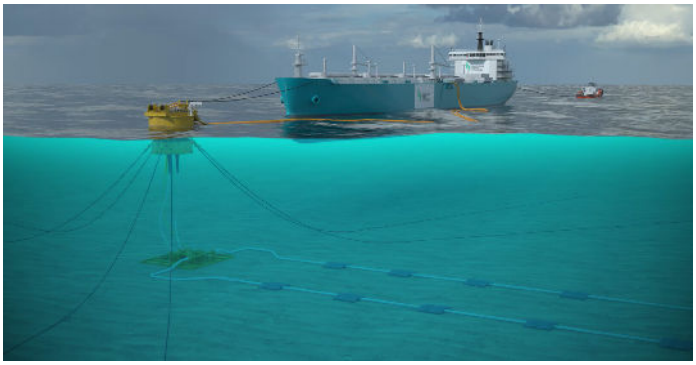


Map of the Marine Export Facility

1. Marine Export Facility

The export facility will have a single point Catenary Anchor Leg Mooring (CALM) buoy which will be approximately 2.5km offshore and ammonia pipelines. This allows for the safe and efficient loading of ammonia onto incoming tankers without the requirement for a breakwater.

It is expected that the tankers' approach to the CALM buoy and connection of the hawsers and loading hoses will take 4-6 hours, assisted by support vessels (e.g., tugboats). Loading of the ammonia and disconnection will take place over a 36-hour window. 3-4 incoming tankers are expected per month when the Project is operating at full capacity.



Graphical representation of loading in action

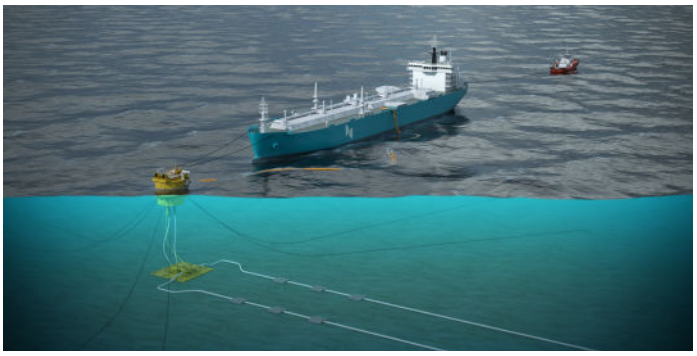
How will the ammonia be transported?

The liquid ammonia, at approximately -33°C, will be transported from the onshore production facility to the CALM buoy through a dual insulated steel pipeline.

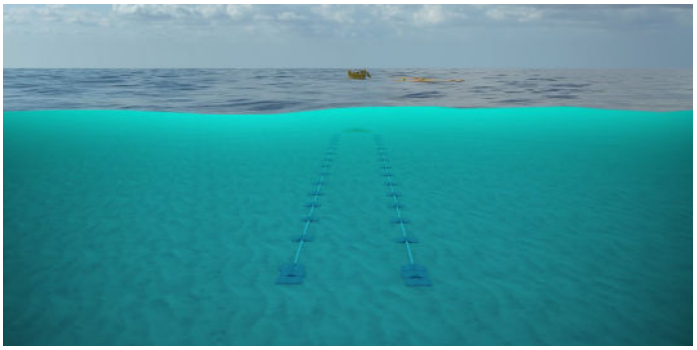
The ammonia pipelines will be installed within a horizontal directional drilled conduit from the crest of the coastal ridge to approximately 1,800m offshore.

Horizontal directional drilling is a construction method that does not require a trench to be dug which minimises surface disruption.

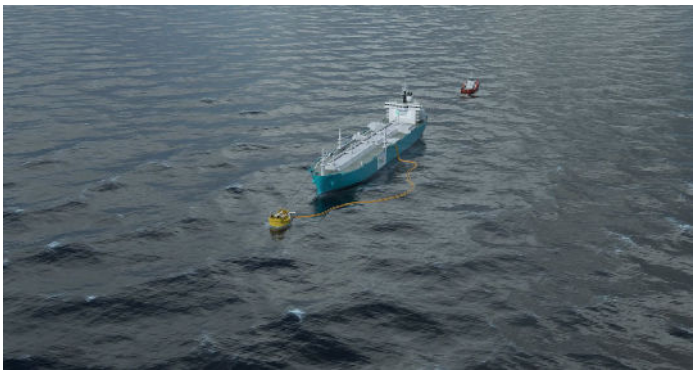
The pipelines will then rise out from under the seabed and run along the sea floor for a further ~700m, stabilised by concrete 'mattresses'.



Graphical representation of the CALM buoy and ammonia pipelines



Graphical representation of the pipeline and concrete mattresses along the seabed



Graphical representation of a tanker being loaded

How does the CALM buoy work?

The CALM buoy's current planned location is at coordinates: 114°2'E 27°24.5'S with a water depth of approximately 38m. This is approximately 35kms north of the mouth of the Murchison River and aligned with the location of the onshore ammonia tanks and Power-to-Ammonia plant. It has been informed by marine environmental survey results and stakeholder feedback.

The final location will be confirmed in conjunction with the Mid West Ports Authority (MWPA), following a mooring assessment.

The buoy itself will be ~15m in diameter and sit ~ 5m above the sea level. It will be secured by 6 mooring lines, each extending ~400m horizontally out from the buoy. A valve manifold will be located on the seabed to allow control of ammonia recirculation and loading.

Due to the design of the CALM buoy, loading tankers will not need to anchor and will 'weather vane' around the buoy, i.e., align with the direction of the wind and rotate accordingly.

2. Seawater supply

The seawater intake and intake conduit will provide the seawater needed for cooling and supply for the desalination plant. The desalinated water will be used as feed to the hydrogen electrolysers.

The seawater intake pipeline will be drilled from a shaft on the coast, which will house the sewater lift pumps and be ~2 metres in diameter.

The intake structure will extend ~700 metres offshore and stand ~6 metres above the seabed. This will allow the water to enter the pipeline horizontally. A coarse intake guard will be fitted over the mouth of the pipe to prevent large fauna and flora from entering.

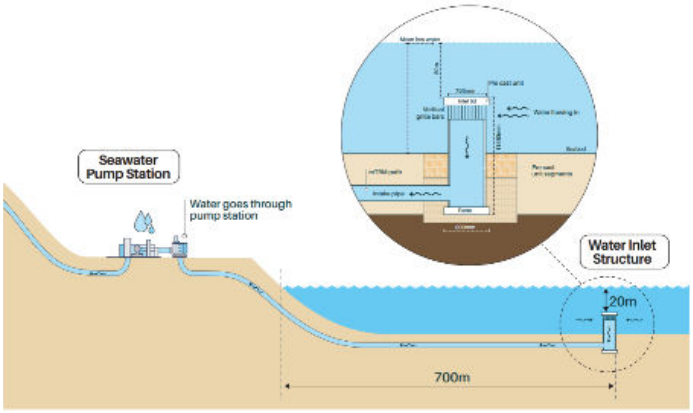


Illustration of the seawater supply infrastructure

3. Brine discharge

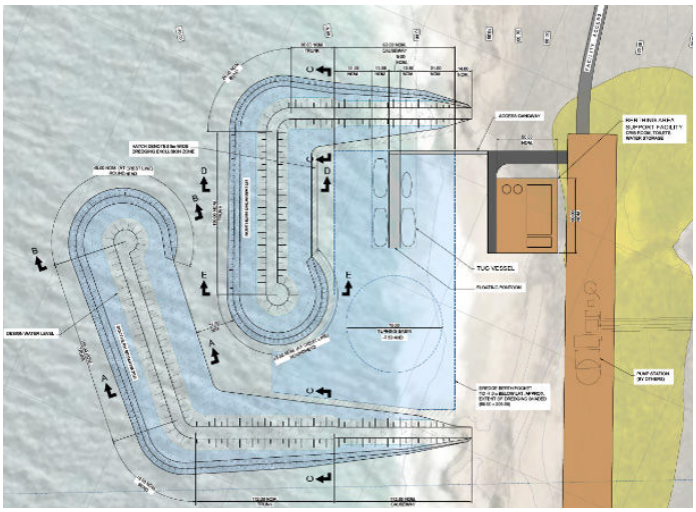
The brine discharge and pipeline will return concentrated seawater from the cooling water blowdown and desalination plant back into the ocean where it will disperse.

The brine discharge pipeline will be ~800mm in diameter and installed by horizontal directional drilling through the shoreline. The brine will be discharged by the diffuser at multiple points along the pipeline at a water depth of ~20 metres. The diffuser is used to mix the brine water with the surrounding sea water as quickly as possible. The salinity and temperature of the brine will be assessed and approved by environmental regulators to ensure there are no unacceptable impacts or harm to marine flora and fauna. It is expected that the concentration of the brine will be up to 2 times that of the surrounding water and 2°C higher in temperature.

4. Support craft facility (SCF)

Support craft, such as tugs and line vessels, are required to assist in connecting the ammonia tanker to the CALM buoy. These will be housed in a Support Craft Facility (SCF), a project-specific harbour. It will comprise of a breakwater and wharf, and up to four vessels such as tugs, line vessels or pilot vessels.

The Project team are currently exploring the viability of other options to remove the requirement for the SCF. An alternative would be to use larger support vessels such as an Anchor Handling Tug Support (AHTS) vessel, which includes crew accommodation. The AHTS vessel would remain at sea for a number of weeks and operate out of Geraldton, where it will be refuelled and undergo a crew changeover. It would not need a dedicated and project-specific support craft facility.



Draft design plans of the Support Craft Facility

Frequently Asked Questions

Is the MEF located in an existing port area?

MGH is engaged with Mid West Ports Authority (MWPA) regarding infrastructure design, layout and operation. A new port area will be established in collaboration with the Department of Jobs, Tourism, Science and Innovation, the Department of Transport, and the Department of Planning, Lands and Heritage, and will come under the jurisdiction and operation of the MWPA.

Will there be exclusion zones?

Exclusion zones will be set by MWPA and in accordance with relevant legislation and government requirements. While still to be confirmed, it is possible that the following exclusion zones may be in effect:

- A permanent exclusion zone around the CALM buoy and floating hoses.
- A permanent "no-anchoring" zone over ammonia pipelines and other subsea infrastructure.
- A temporary exclusion zone around CALM buoy while ships are loading.

Will Ammonia be released into the environment?

The facilities will be designed to avoid the release of ammonia into the environment.

To ensure the integrity of the Marine Export Facility, the State Safety Regulator, the Department of Mines, Industry Regulation and Safety (DMIRS) requires the system design and operation to incorporate features to detect any leaks and provide active shut-off systems to minimise the volume discharged, including:

- Static leak testing prior to each loading, with a pressurising system, to ensure that there is no drop in pressure which may indicate a leak.
- Monitoring ammonia flow in and out of the system to detect any discrepancies.
- Onsite monitoring of the surrounding waters to detect any traces of ammonia.
- Shut-off valves at the CALM buoy, on the subsea manifold and onshore.

As part of the environmental approvals submission, the project is undertaking ammonia spill modelling and impact assessment studies to determine the potential impact of an unlikely release event.

What will be the effect of the brine discharge?

Brine dispersion analyses are currently being undertaken and findings so far indicate that the brine disperses to required concentrations within the mixing zone, in line with regulatory requirements. The brine discharge is expected to have limited impact on the local environment.

What will be the effect on local fishermen?

Aside from the exclusion areas, which represent a small percentage of the total marine area, there should be minimal impact on local fishermen.

MGH will continue to engage with commercial fishing operations that utilise the MEF area.

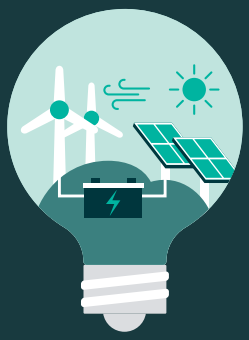
How will offtake occur in the rough local sea climate?

Offtake will be allowed, only during periods when the wave height is sufficiently low to allow safe hook-up of the ammonia tankers to the CALM buoy. The frequency of safe offtake windows has been assessed using 10 years' worth of historical wave height data and validated by 1 year of onsite measured data using a waverider buoy. The waverider buoy is a specialised floating device used to capture, measure and record wave characteristics including height, duration, and direction.

Ammonia storage facilities have been sized to ensure that ammonia production can continue between offtake windows, allowing for delays due to weather.

Tanker handling and mooring simulations will be undertaken, under the direction of the MWPA, to ensure that the CLAM buoy's location allows for safe approach given the local coastal conditions.

Visualisation of loading in process from the coast onsite



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